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DIVISION OF FORESTRY.

FOREST AND ORNAMENTAL TREE SEED AND SEEDLINGS FOR SALE AT THE GOVERNMENT NURSERY.

The Division of Forestry keeps constantly on hand at the Government Nursery, seed and seedlings of the important native and introduced trees. These are sold at prices just covering the cost of collection or growing.

The list includes both forest and ornamental trees, such as Silk Oak, Koa, various species of Eucalyptus, Golden and Pink Showers, Pride of India, Poinciana, Albizzia, etc. The price of the seed varies from 10 to 50 cents per ounce. The seedlings may be had for 2½ cents each, except a few kinds which are 5 cents. Seed of the various palms is also for sale; the price per 100 varying from $1.00 to $2.50. All seed is tested before being sent out, which insures its being good.

All communications in regard to seed or trees should be addressed to David Haughs, Forest Nurseryman, Box 207, Honolulu, Hawaii.

RALPH S. HOSMER,
Superintendent of Forestry.

DIVISION OF ENTOMOLOGY.

To give information about insects free of charge is one of the duties of this Division and Hawaiian readers are hereby invited to make inquiry in person and by mail. In order to be able to advise intelligently or send the right kind of useful insects for relief we like and sometimes it is indispensable for us to see the insect suspected or caught in the act, also specimens of the injury. In a tin with a hole or two, or a wooden box specimens may be mailed at 3rd class rates. When specimens are not accompanied by letter *always* write your name and address in the upper left-hand corner of the package. Address all communications SUPERINTENDENT DIVISION OF ENTOMOLOGY, P. O. BOX 207 HONOLULU, HAWAII.

EDW. M. EHRHORN,
Superintendent.

THE HAWAIIAN

FORESTER & AGRICULTURIST

VOL. X. JULY, 1913. No. 7.

Some idea of what the Territory of Hawaii owes to the Division of Animal Industry may be obtained from a perusal of the monthly reports thereof in this number. The promptness with which suppressive and preventive measures are taken whenever any disease among live stock is reported saves many thousands of dollars of loss every year. It is very gratifying, also, to have evidence that the methods of the official veterinarians exemplify the latest word in scientific practice.

It would be impossible to imagine, after considering the reports from month to month of the Division of Entomology, what the condition of agriculture in Hawaii would be were the constant fight to exclude and exterminate pests suspended even for one month.

Attention is directed to the notice by Mr. Hosmer of the bulletin on Hawaiian names of plants and the book on indigenous trees of Hawaii, both written by Mr. Rock.

"The aim of the Division of Forestry," Mr. Hosmer says in his June report, "is to be of direct and practical use to the people of the Territory." This none can gainsay who have knowledge of the progress made in forestry in these islands since the small practical beginning made in governmental forestation a little over a quarter of a century ago, the greatest strides having been made since Mr. Hosmer, subsequent to annexation, placed the work on a scientific basis. Prior to that time, however, the sugar planters were taking a lively interest in tree planting, as a result of which there are many fine growths of forest throughout the islands. How their interest continues is evidenced by the demands they are making on the government nursery, of which the 16,000 plants taken by them in June last past constitute but an ordinary monthly incident. In the Eastern States just now municipalities are planting forests with the expectation of returns in due time which will do away with the necessity of civic taxation. If that can be done there, what possibilities of forestry are not present in Hawaii, where the growth of trees is so much more rapid?

In this issue the publication is begun of a treatise on "The Kalo in Hawaii," of which Professor MacCaughey and Mr. Joseph Emerson are the authors in collaboration, the former as botanist and the latter as historian. Judging by the introductory chapter forming the first instalment, the brochure is one that will attract much interest at home and abroad.

An article in this number on "Insect Control," by C. R. Jones, the Philippine entomologist, seems to contain much matter of useful applicability to Hawaii.

Various short selected articles, relating to diversified agriculture of kinds already existent in Hawaii or adapted to its soil and climate, will be found in this number.

A review of a bulletin of the experiment station of the University of Illinois, on tubercle bacilli, appears in this number, which ought to be of much local interest in view of the campaign against bovine tuberculosis which has been so successfully established on the Island of Oahu and must in time be extended to cover the whole group.

DIVISION OF ANIMAL INDUSTRY.

Honolulu, June 30, 1913.

Hon. W. M. Giffard, President and Executive Officer, Board of Agriculture and Forestry, Honolulu, T. H.

Sir:—I beg to present herewith the report for the Division of Animal Industry for the month of June, 1913:

ANIMAL QUARANTINE STATION, HONOLULU.

The complete reconstruction and enlargement of the Station which has been under way for the past three months has been finished. The main parts of this work come under the following heads:

(1) *Dog Quarantine Section.* As already reported, six additional enclosures were provided, making a total of 24 individual enclosures, more than half of which can be made to hold two or more dogs, if the same belong to one owner or arrive approximately at the same time. The most important improvement, however, is the reinforcement of all the enclosures with a concrete embankment 12 to 18 inches wide along the inside of the foot boards, making it impossible for an animal to dig out and escape. This arrangement in no way detracts from the sanitation of the pens,

as the main part of the enclosure remains unchanged; that is, the original beach sand through which all excretions likely to contaminate the kennels may percolate to the tide water below. (2) The horse and mule section has now been completely rebuilt, the number of posts in the fences being almost doubled, so that the distance between them in no case exceeds eight feet. The stability has also been greatly increased by connecting all the posts with a 2″x4″ stringer spiked to the top. This will prevent the animals from "riding" on the fence and will thereby double the life of the enclosures. All gates have been reinforced and rehung and a mixture of oil and sand applied to all woodwork exposed to the teeth of the animals.

A small chamber 9′x12′ has been added to the office so that the keeper may have a place to sleep and keep his clothes, for which purpose the office has hitherto had to serve.

HILO QUARANTINE STATION.

Dr. Elliot reports progress with the construction of this station, though the contractor has had trouble with his laborers. He seems, however, to be satisfied with the work so far as it has gone, and expects the station to be finished by the latter part of July. He further recommends that the keeper, when he secures one, be provided with some tools—spade, shovel, pick, wheelbarrow, etc.—so that he can put him to work gathering rock for the road and stable floors.

HOG CHOLERA.

As previously reported, this disease has spread to a considerable extent and many animals have died. The method of control now in vogue in the States—the injection, subcutaneously, of blood serum obtained from hogs which have been hyperminimized against the disease—has been applied here and with seeming success; in fact, with highly satisfactory results. It may, for instance, be mentioned that in one herd of 20 to 40 animals of all sizes, and all of which were affected with the disease, some to such an extent that they could not walk, practically every one which was inoculated has either recovered or else improved, while two, which escaped inoculation by breaking through the fence, developed the disease and one of them has died, while none of the treated hogs have been lost.

The establishment of a serum institute for the manufacture of hog cholera serum here has been considered in view of the price asked for the commercial serum, which amounts to from two to three dollars for full-grown hogs. There is, however, considerable danger of spreading or perpetuating the disease here, as it is necessary to keep on hand animals infected with the most virulent

form of the disease, and in view of the limited number of hogs in the Islands the cost of manufacturing the serum here would no doubt prove exorbitant.

Special inquiries in regard to the prevalence of this disease on the other islands have been directed to the deputies of this office, but from the replies received it would appear that the present outbreak is confined to the Island of Oahu. It is therefore recommended that a regulation be promulgated at once prohibiting the shipment of hogs from Oahu to any of the other islands, temporarily. If this is approved by the Board, I would respectfully recommend that the appended Rule be acted upon at once. As the disease seems to have spread over the entire Island of Oahu, even as far as Waimea and Kahuku, it does not seem possible that anything can be accomplished by regulations prohibiting the transfer, interchange or shipping of hogs from one port of this island to another. On the other hand, it would be advisable to call the attention of the Board of Health and the Board of Supervisors to the fact that hog cholera is prevalent and that the respective Boards take steps to protect the public against the marketing and consumption of pork from hogs which have not passed a rigid ante, as well as post-mortem, inspection, such as is required by the Federal Bureau of Animal Industry. These regulations are plain and to the point, without being onerous, and as it was intimated to me only yesterday that pork had been offered for sale at ridiculously low prices, it is safe to conclude that such pork originated from pigs that had died from cholera. The disease is, however, not transmissible to human beings, nor to any of the other domesticated animals, for which reason the federal regulations permit the marketing of hogs exposed to the infection and allow the consumption of the pork so long as the animals have not developed the disease to such an advanced degree as to affect the wholesomeness of the pork.

"Territory of Hawaii, Board of Agriculture and Forestry, Division of Animal Industry.

"Rule VII: Prohibiting the shipment, transfer or exchange of hogs from the Island of Oahu to any other island of the Territory of Hawaii.

"It having come to the notice of this Board that a disease known as hog cholera or swine plague is prevalent among the hogs on the Island of Oahu, it is hereby ordered:

"Section 1. Until further notice no hogs (of whatsoever age, breed, or description) shall be shipped, carried or transferred from the Island of Oahu to any other island of the Territory of Hawaii.

"Section 2. This order shall take effect upon its approval by the Governor."

CEREBRO SPINAL MENINGITIS.

This highly fatal disease among horses and mules has fortunately not spread to the extent that it was feared might result from the heavy rains following a prolonged drought. The outbreak at Fort Shafter resulting in the death of four mules may possibly be ascribed to some other cause, that is, poisoning with a weed contained in the hay (imported from California) which was being fed to these animals at the time of their death. Fortunately some of this hay was secured, and as will be seen from the appended letter from Mr. Rock, botanist to the College of Hawaii, the hay contains not less than ten per cent. of the poisonous weed in question. What remains of the bale, about 40 lbs., is being fed to a mule in order to ascertain whether the weed in question could have been the direct cause of the death of these four mules.

On the other hand, Dr. Fitzgerald reports an extensive outbreak of cerebro-spinal meningitis on the Island of Molokai, with 30 or 40 animals affected with about ten deaths. He also reports a number of scattered cases of the same disease on the Island of Maui. From Hawaii and Kauai no definite information has been received, so it is to be presumed that, for the present at least, the danger of a severe outbreak seems to have passed.

RABIES AND HYDROPHOBIA.

The newspapers from California and adjoining states and the official reports of live stock commissions and live stock sanitary boards indicate that this disease is far from being suppressed, and the number of human beings, especially children, reported to have been bitten by mad dogs seems to be constantly increasing. On top of that it appears that the health authorities of San Francisco have been prevailed upon to rescind the muzzling act, on account of the hot weather, and substituting it with an order that all dogs must be in leash when on public highways or streets. This is the same fatal mistake that has perpetuated the disease in so many other countries, causing numbers of deaths and untold suffering. Only those countries which have enforced the continuous muzzling of all dogs in public places, in connection with stringent quarantine of all imported dogs, have succeeded in exterminating the disease. From personal observations for the past twenty years I feel convinced that this abrogation of the muzzling act in San Francisco will result in an immediate increase in the number of cases of rabies, and it consequently becomes necessary for us to increase our vigilance against the disease gaining an entrance here. For this reason I have to express my appreciation of the support of the Board in perfecting the dog quarantine station to a point where even the most fastidious cannot raise a single

objection to the detention of their dogs for a period which to many seems exorbitant and unnecessary.

Very respectfully,

V. A. NORGAARD,
Territorial Veterinarian.

REPORT OF ASSISTANT VETERINARIAN.

Honolulu, June 28, 1913.

Dr. V. A. Norgaard, Chief of Division of Animal Industry.

Sir:—I beg to submit herewith my report for the month of June, 1913:

Tuberculosis Control.

The appointment of Mr. Richards, past city and county milk inspector, as assistant to this division by the Board of Commissioners, has enabled us to take up again the tuberculin testing of dairy cows as required by the municipal milk ordinance. The fourth general test of the dairy herds of the city and county of Honolulu has now commenced and is progressing rapidly. Since June 9 twenty-nine (29) dairies have been visited and a total of one thousand one hundred and thirty-two (1132) animals subjected to the test, out of which number, as far as we are able to report at the present time, 49 cows have been condemned. The following tabulated list gives the name of each dairy visited, with the total number of animals tested, passed and condemned in each:

		T.	P.	C.
June 9-12—	Joe Gouviera	41	40	1
	N. B. Brown	39	39	0
	M. Salina	30	28	2
	J. W. L. McGuire	20	19	1
	S. I. Shaw	22	22	0
	S. T. Grace	7	7	0
	Waialae Dairy	59	55	4
	Chas. Lucas	29	29	0
June 13-16—	Waialae Dairy	234	226	8
	R. Compos	79	74	5
June 14-17—	Chas. Lucas	53	46	7
June 17-19—	Jose Gonzallas	35	33	2
	R. A. Franco	20	19	1
	Nishimoto	10	10	0
	M. M. Pedro	20	20	0
June 18-21—	J. M. Whitney	13	12	1
	J. H. Cummings	6	6	0
	W. E. Wall	13	12	1

June 20-23—Waialae Dairy	128	121	7
W. P. Alexander	5	5	0
June 23-26—J. H. Cummings	1	1	0
W. E. Wall	1	1	0
I. Nagaki	22	21	1
H. E. Cooper	19	19	0
June 24-27—T. F. Farm	73	68	5
F. Medieros	20	20	0
P. Miyakawa	15	15	0
K. Inouye	14	14	0
K. Yamashita	17	17	0
M. K. Young	15	14	1
S. Hirata	20	20	0
June 25-28—Oahu College	15	15	0
Mills Institute	18	18	0
College of Hawaii	19	17	2

It is very encouraging to note that considerable improvement has taken place in Mr. Isenberg's herd in the last five months. In January, 1913, a total of 470 animals were tested at Waialae and 63 condemned, the percentage of diseased animals being 13.4%. This month a total of 421 animals were tested and 19 condemned, the percentage of diseased animals being 4.5, which is a very great improvement. Under the efficient management of the ranch at the present time, where thorough disinfection of all barns is immediate, and absolute segregation and early slaughter of all condemned animals is practiced, improvement in the herd is bound to be rapid. Mr. Isenberg is to be congratulated on the consistent way in which he has fought this disease, which was present to such an alarming extent in his herd four years ago, and on the good results which are now being realized.

I have been fortunate enough to be able to make post-mortem examinations on four cows condemned on this test and have found all affected with the disease to a greater or lesser extent. The results of these examinations are as follows:

One cow from Joe Gouviera's herd. The animal was in fine condition; the reaction was large and of a typical character. Post-mortem lesions of the disease consisted of a few small nodules in the bronco-esophagal glands; all other organs in the body clean.

Three cows from Charles Lucas' dairy were killed at one of the local slaughter houses, resulting as follows:

No. 1. Condemned on the 17th and slaughtered on the 19th. Swelling at point of inoculation still present. The presence of the disease was shown by a few small nodules in the sub-lumbar lymph glands; all other organs in the body clean.

No. 2. Swelling at point of inoculation still present; retro-pharyngeal glands contained a few small nodules; diaphragm-

atic lobes of the lungs contained three tuberculous abscesses, one of which was double the size of the closed hand. All contained the characteristic gritty pus.

No. 3. Swelling at point of inoculation still present. Disease present in the left retro-pharyngeal gland, which was greatly enlarged, measuring 5″ long and 3″ wide and filled with tuberculous pus. All other organs in the body clean.

In all of the above animals the disease was of a localized nature and the carcasses in fine condition, and the meat was therefore passed for food. As has been noticed before, the size of the local swelling constituting a reaction has no definite relation to the amount of disease in the animal body, as sometimes a very pronounced reaction will be observed when the lesions are small and few in number. There is no doubt that there is nothing constant in the size of swelling, and that an animal may at one time give a pronounced reaction and at another time a swelling half the size. The degree of reaction varies as the anaphylaxis of the animal tissues is of a high or low degree, and this degree cannot at all times express correctly the amount or stage of the disease, as it is conceivable that when first infected and when the disease is becoming established the tissues of the body would be in a highly sensitive state, and the injection of the toxins in the tuberculin cause a violent reaction and the following post-mortem examination would have to be careful indeed to discover the seat of the lesions.

The anaphylaxis brought about by the presence of the disease in the various organs of the body will vary as the vitality of the system varies and whether the disease is in a quiescent or active stage. It is probable that when the disease is extensive in the body the anaphylactic properties of the disease, the skin in particular, are much lowered, and as the disease progresses become less and less until at times it is entirely nil, and this condition may last for greater or lesser periods of time. Thus it is conceivable that such an animal would not give a reaction to the toxins injected and so pass the tuberculin test when extensively affected with the disease.

The post-mortem examinations I have been fortunate enough to make since the intradermal method was inaugurated have been positive; that is, the disease has been present in every case. On the other hand, I have learned of examinations being made on condemned animals where no lesions have been found. In establishing a method of testing, negative findings are as valuable as those cases which are of a positive nature. From the results thus far experienced in the use of this method, we are still firmly convinced of the great value of the intradermal method and of its equal reliability to the subcutaneous test, which has been demonstrated to be reliable in 98.36 per cent. of cases.

The following list of live stock was allowed to enter the port of Honolulu during the past month:

June 4—S. S. Korea, San Francisco: 1 dog, Lieut. H. S. Green; 1 crate Bl. Plymouth Rocks.

June 5—S. S. Ascot, Europe: 5 cats, immigrants.

June 9—S. S. Sonoma, San Francisco: 1 crate guinea hens.

June 10—S. S. Wilhelmina, San Francisco: 4 crates poultry; 1 dog, W. P. Reeves.

June 16—S. S. Chiyo Maru, Orient: 1 dog, Capt. Bennett; 1 crate Japanese game.

June 17—S. S. Honolulan, San Francisco: 15 horses, 2 mules, 1 colt, D. Ferriera; 4 horses, 22 mules, 1 bulldog, Schuman Carriage Company; 1 bulldog, Capt. C. W. Waller; 7 crates chickens, N. B. Lansing.

June 17—S. S. Virginian, Seattle: 24 mules, Chas. Bellina; 39 horses, 2 sheep, 16 pigs, 2 cows, A. L. McPherson.

June 18—S. S. Siberia, San Francisco: 1 Boston bull terrier pup, Carl T. Schaefer.

June 18—S. S. Niagara, Vancouver: 1 white boar, T. H. Davies & Co.

June 23—S. S. Sierra, San Francisco: 49 crates poultry.

Respectfully submitted,

L. N. CASE,
Assistant Territorial Veterinarian.

DIVISION OF ENTOMOLOGY.

Honolulu, June 30, 1913.

Board of Commissioners of Agriculture and Forestry.

Gentlemen:—I respectfully submit my report of the work of the Division of Entomology for the month of June as follows:

During the month 39 vessels arrived at the port of Honolulu, of which 21 carried vegetable matter and one vessel moulding sand.

Disposal.	Lots.	Parcels.
Passed as free from pests	1129	16,929
Fumigated	11	32
Burned	65	74
Prohibited from entry	1	1
Total inspected	1206	17,036

Of these shipments, 16,282 packages arrived as freight, 84 packages by mail and 670 packages in the baggage of passengers

RICE.

During the month 21,876 bags of rice arrived from Japan. All the various lots were examined and found free from pests and were then released. All the rice had been fumigated at Kobe.

PESTS INTERCEPTED.

Twenty packages of fruit and 45 packages of vegetables were found in the baggage of passengers and immigrants from the Orient, as well as those which arrived from Spain on the steamer Ascot. Of the latter each piece of baggage was carefully searched for seeds which were thoroughly examined and fumigated. Several lots, being badly infested, were burned. Four large baskets of sweet potatoes from Hongkong were found infested with the sweet potato weevil and were ordered destroyed. A small lot of beans from Manila in the mail was found infested with the Chinese bean weevil (*Bruchus chinensis*) and was fumigated before being released. Two orchids badly infested with mealy bugs and the orchid scale (*Chrysomphalus biformis*) were destroyed. An ants' nest with many young larvae and pupae was found in a bale of moss coming from England. The shipment, consisting of three large bales, was fumigated for 48 hours with carbon bisulphide and after the treatment we found the ants dead. A small package of native limes from Australia was found in the mail. The fruits were infested by a few caterpillars feeding on the peel. As these were sent for experimental purposes to the U. S. Experiment Station, we saved the seeds, put out fruit in alcohol for a sample and destroyed the pulp of the other fruits.

BENEFICIAL INSECTS.

One lot of Colosoma beetles was sent to the Division of Entomology by Dr. A. F. Burgess of the Gypsymoth laboratory, Melrose Highlands, Massachusetts. This is the fourth sending we have received and from this lot of 25 beetles, eight were liberated up Manoa Valley, where one of the 1912 sendings was placed. The *Colosoma* beetles are of great benefit, as they feed on cutworms and the larvae of many injurious insects. It is doubtful whether or not the beetles will become established owing to the great difference in climate.

Two packages of parasitized aphids came to Mr. O. H. Swezey of the H. S. P. A. Experiment Station from Mr. Fred Muir, also of the H. S. P. A. Experiment Station, and before these were passed they were opened in my presence. I understand that Mr. Swezey has been able to liberate quite a few parasites, which, if they become established, will no doubt assist in keeping in check some of the aphids which infest our vegetable and flowering plants.

HILO INSPECTION.

Brother M. Newell reports the arrival of nine vessels, five of which brought vegetable matter consisting of 107 lots and 1866 parcels. Seven bags of pineapple plants were inspected and fumigated before shipment from Hilo to Maui; they were slightly infested with mealybugs.

INTER-ISLAND INSPECTION.

During the month of June 56 steamers were attended to and the following shipments were passed:

Plants	64	packages
Taro	649	bags
Fruit	23	packages
Lilyroot	15	"
Total passed	751	

The following packages were refused shipment:

Fruit (on account of infestation)	20	packages
Plants (on account of soil and infestation)	6	"
Total refused shipment	26	"

STAFF.

On June 3 Mr. J. C. Bridwell arrived from the Coast to act as assistant superintendent of entomology, and is now assisting in the breeding of the parasites of the Mediterranean fruit fly.

Respectfully submitted,

E. M. EHRHORN,
Superintendent of Entomology.

DIVISION OF FORESTRY.

Honolulu, June 30, 1913.

Board of Commissioners of Agriculture and Forestry, Honolulu.

Gentlemen:—I have the honor to submit as follows the routine report of the Division of Forestry for June, 1913:

FOREST RESERVES.

On June 4, Governor Frear signed a proclamation creating three forest reserves in the Waianae District—Oahu-Nanakuli, Makua-Keaau, and Kuaokala—of which mention was made in my May report.

During this month there have been submitted to the Board reports recommending the setting apart as forest reserves (1) of the watershed on the mountains immediately back of Honolulu, (2) of the Waiakea-Olaa forest on Hawaii, (3) of the summit of the Kohala Mountain, Hawaii, with certain adjoining lands, and (4) a modification of boundary in the Moloaa Forest Reserve on Kauai.

HAUULA FOREST FENCE.

On June 25 I visited the Government land of Hauula in the Koolauloa District on this island, in company with representatives of the Hauula Homesteaders' Association, went over the ground and flagged the line of the proposed forest fence across the mauka portion of this land, on the location approved by Governor Frear in May, 1913.

PREPARATIONS FOR THE COMING FISCAL PERIOD.

Not a little time during June has been given to preparing detailed plans and outlines for the forest work to be carried on during the fiscal period beginning July 1, especially with reference to the fencing of forest reserve boundaries on Government land. In addition to thus providing for better protection for the native forest, it is the intention of the Division of Forestry to continue its regular work of growing and distributing trees from its several nurseries and of giving information and advice on forest matters, along the lines that it has followed in the past few years. The aim of the Division of Forestry is to be of direct and practical use to the people of the Territory. The calls that are made on this office prove that there is an active demand for such service.

BOTANICAL BULLETIN.

At the end of the month there was issued as Botanical Bulletin No. 2, a "List of Hawaiian Names of Plants," by J. F. Rock, consulting botanist of the Board of Agriculture and Forestry. This is a twenty-page pamphlet giving the Hawaiian, the botanical, and, where there is one, the English name of a large number of indigenous trees and shrubs. An edition of 1500 copies was struck off.

In this connection it may not be out of place to make mention of the appearance on June 26 of Mr. J. F. Rock's book, "The Indigenous Trees of the Hawaiian Islands." This volume gives technical and popular descriptions of over 400 trees, many of which are illustrated by excellent full-page plates from photographs taken by Mr. Rock. The more technical part of the book is preceded by a general account of the forests and forest types in Hawaii that add much to its value.

A good part of the botanical material on which the descriptions are based was collected by Mr. Rock while actively a member of the staff of this Board. The original specimens are in the Herbarium of the Board, now on deposit with the College of Hawaii.

Mr. Rock's book is not only a highly important scientific contribution; it is as well a work which can be used to advantage and with satisfaction by the general public. Issued under the patronage of subscribers, the book is now on sale in Honolulu.

NURSERY NOTES.

During June a new soil sterilizer has been installed at the Experiment Garden in Makiki Valley. At the Government Nursery the remodeling of the stable buildings has been completed, along with the relocation and repair of some of the other smaller service buildings. I transmit, as usual, the report of the Forest Nurseryman.

Very respectfully,

RALPH S. HOSMER,
Superintendent of Forestry.

REPORT OF FOREST NURSERYMAN.

R. S. Hosmer, Esq., Superintendent of Forestry.

Dear Sir:—The following report gives the principal work done during the month of June:

Nursery.

Distribution of Trees.

	In Seed Boxes.	In Boxes Transplanted.	Pot Grown.	Total.
Sold	....	...	113	113
Gratis	3000	410	425	3835
Total	3000	410	538	3948

Collections.

Collections on account of plants sold amounted to	$ 2.25
Rent of building, Nursery grounds	35.00
Total	$37.25

Plantation Companies and Other Corporations.

The distribution of plants as per heading amounted to 10,000 in seed boxes, 5000 in transplant boxes, and 1000 pot grown. Total, 16,000.

For a few months during the summer the distribution of plants is always small and we are therefore able to do some needed repairs to buildings, etc., with our own men. In addition to assisting in the remodeling of buildings at the Nursery, we have commenced to repair the forestry cottage on Tantalus. This cottage has been in a disreputable condition for a number of years and an eyesore to people passing that way. A couple of weeks' work with our own men will put it in good condition.

The pest known as Jerusalem Thorn (Parkinsonia Aculeata), which was discovered about a year ago growing on Quarantine Island, has been all dug up and burned. A gang of prisoners kindly granted by Sheriff Henry did the work.

Experiment Garden, Makiki.

The new soil sterilizer has been installed and is a great success. The saving of fuel and labor when compared with the old one justifies the expense that has been put on it.

A large stock of plants is being propagated for the fall planting.

U. S. Experiment Planting, Nuuanu Valley.

The man has been transplanting into tin cans more new varieties of Eucalyptus, also hoeing and attending to the plats already planted.

Very respectfully,

DAVID HAUGHS,
Forest Nurseryman.

THE KALO IN HAWAII. (I.)

By VAUGHAN MACCAUGHEY and JOSEPH S. EMERSON.

PREFACE.

The material in the following pages has been gathered by the authors from personal observations of kalo production, from extended conferences with many Hawaiian "taro-planters," and from a survey of important literature.

So far as is known, this is the first comprehensive collaboration of information relative to the Hawaiian kalo. It has been prepared with the hope that it may serve as a basis for research work. The Hawaiian kalo is a plant of great ethnologic and agricultural interest. It deserves far more attention than has yet been ac-

corded it. These articles may indicate a few of the many approaches towards this plant of venerable antiquity.

The name *kalo* is used throughout this series, in preference to the modernly-used *taro*. The authors felt that this plant should be designated by its original and authentic Hawaiian name.* The authors realize the many gaps and incompletenesses that necessarily characterize a series of this nature. Many of the topics are treated suggestively—for example, an exhaustive study of the mythology of Hawaiian kalo is yet to be made. This series is to be considered as a reconnoissance.

1. INTRODUCTION.

The kalo is one of the most important food plants utilized by the human race. Together with its immediate relatives, it has been intensively cultivated by peoples of the tropics and subtropics since the dawn of man's dominion over nature. Kalo has always been the chief food of the Hawaiian race, and of many other peoples of Oceanica.

At this point attention may be properly directed to some of the salient features of the Hawaiian Islands and the Hawaiian people, with special reference to kalo production.

The Territory of Hawaii consists of an archipelago two thousand miles long, in the North Pacific Ocean. It is 2100 miles west of San Francisco and 4700 miles east of Manila. These islands were discovered by Captain Cook in 1778. The land surface of the eight inhabited islands aggregates about 6500 square miles, being a little less than the State of New Jersey. The largest island, Hawaii, has an area about the same as Connecticut.

To the northwest of the larger islands lies a series of tiny coral atolls and barren rocks, the majority of them scarcely rising above the surface of the sea. These have a combined area of less than six square miles, and are of no agricultural significance, save as sources of guano.

This chain of islands is of volcanic origin. Volcanic activity has evidently moved southeastward along well-defined fissures. The smaller, most deeply-eroded islands, having fewest traces of recent volcanic action, are to the northwest, while to the southeast they are larger, less eroded, with fresh lava flows and other indications of late eruptions. Indeed, on Hawaii itself, the largest and most southerly of the islands, are the two great active volcanoes, Kilauea and Mauna Loa. On this island lava-flows and other volcanic phenomena occur at relatively frequent intervals.

The four million acres that comprise the land area of Hawaii are of the following types: waste land, 32%; forest land, 25%; grazing land, 33%; arable land, 6%; reclaimable land, 4%. Water

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* **Kalo and taro are merely dialectic variations of the same word.**

supply and altitude are the chief factors in the productivity of the agricultural lands. Of the arable land, the most valuable is that having water rights and utilized by the kalo, rice, and sugar plantations. This aggregates about 213,000 acres, on the alluvial flats and lower slopes. Above or adjacent to these areas is a belt, aggregating 1,500,000 acres, too high or too dry for sugar-cane, and so used for grazing.* Higher up on the mountain slopes, in many places extending well up towards the summits, are the forests, which constitute invaluable water reserves for the lower lands.

The lands of Hawaii are owned as follows: Public lands, 40%; corporately owned (chiefly sugar and pineapple plantations), 39%; individual Americans, 10%; individual Hawaiians and part-Hawaiians, 9%; individual Asiatics, 2%. The land was owned at one time entirely by the Hawaiian aborigines, who were pre-eminently farmers, and who developed a highly intensive system of cultivation. Arable land and available water were utilized to a maximum degree. The food supply of the early Hawaiians came almost wholly from the fertile lowlands that engirdle the islands, and from the bounteous ocean. Kalo, sweet potatoes, yams, bread-fruit, bananas, coconuts, sugar cane, and wild fruits constituted their vegetable food. Fish, swine, fowl and dog supplied the remainder of their diet. The pounded corm of the kalo, forming a starchy and acetic paste called *poi,* was their "staff of life," and "Fish and poi" is still a by-word for a meal.

"The limited area of the islands restricted nomadism; the entire lack of big game cut off hunting; and the absence of grazing domestic animals prevented pastoral life." Thus this peaceful, kindly people became, by force of circumstance, skilful farmers. Their ancient practices are unfortunately decadent, and little survives but deserted kalo patches, neglected groves of bananas, and slow-dying coconut plantations, to tell of the minute system that once drew tribute from every foot of good land, and was so marvelously adapted to local conditions.

During the middle of the last century there were about 11,000 native landowners, each occupying and tilling minute *"kuleanas"* of from a fraction of an acre to three acres in extent. "This division of the land illustrates the fact that the needs of the common people were filled and a relatively high state of culture developed by individual work on very small tracts; in fact, the native under best conditions can rarely make use of a larger area."—Newell.

If there is any relationship between food and physique, kalo is to be highly commended, for the ancient Hawaiian, according to unanimous report, had a superb physical development. This

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* In recent years much of this grazing land has been converted into pineapple fields.

statement must, however, be somewhat qualified. Among the Hawaiian women (and to lesser degree among the men), especially after middle age, the *poi* diet has frequently a very marked fattening effect. This tendency towards obeseness is unquestionably due to the excessive starchiness of the diet, as well as to other causes. The finest forms are to be found among the young men and women. This statement also applies to Polynesia in general. Not only has kalo gained wide repute because of the healthful and easily-digested food derived from it, but attention has also been attracted to its heavy yields per acre. A few square rods, under proper cultural methods, will continuously produce enough kalo to support a large family. It is due to this great productivity that ancient Hawaii, despite its very limited area, was able to support a relatively dense population. Kalo is prominent among the plants recently recommended by the United States Department of Agriculture for planting in some of the Southern States.

Mr. T. F. Sedgwick reports that "taro holds about fourth place among the products of Hawaii, at least in area of land devoted to its cultivation, and probably also in total value of crop. The investment in taro growing approximates from $450,000 to $500,000. It is practically all consumed in Hawaii, the export of taro flour or "Taroena" amounting to but a very small percentage of the total crop.

"Taro cultivation is profitable, and land suited to its cultivation, provided it has water rights, brings a high annual rental. The average annual rental per acre in the vicinity of Honolulu for "taro land" ranges from $30 to $50. The average retail price of *poi* in Honolulu ranges from 2½ to 5 cents per pound. One acre will generally produce from twelve to fifteen tons, which sells for $1.75 to $2.50 per hundred pounds. * * *

"The available irrigated taro land is about all occupied. The opening up of new areas for its cultivation would be dependent, either upon the discovery of sources of additional water supply, or upon more careful use of the water now available.

"Although taro has been the staple food of the Hawaiians * * * the probabilities are that the time will come within the next one or two generations when a large share of the taro lands now in cultivation will be planted to other crops." Considerable areas formerly cultivated in kalo are now devoted to rice.

Mr. Barrett, in a U. S. Department of Agriculture bulletin on "Promising Root Crops for the South," writes: "The economic aroids of the world have received very little attention outside of a few tropical countries, yet some of them bid fair to become of great commercial importance within a few years, for the following reasons: They are adapted to soils which are too wet for other root crops, such as sweet potatoes and cassava; they grow rapidly, if given a fairly rich soil and a fair amount of moisture;

they yield heavily, in some cases two to four times the average yield of potatoes; * * * their keeping qualities are in most cases excellent, whether kept in the ground in situ or in a dry place in bags; and they are resistant to insect and fungus pests."

These statements are all applicable to the Hawaiian kalo; indeed, it is probable that no other aroid possesses these valuable agricultural qualities to the degree in which they are manifested in the kalo. As rice among the cereals, as coconut among the palms, so is kalo chief among the aroids.

2. LEAVES.

These, in Hawaiian, are designated *lau-kalo, lau-alo,* or *la-alo.* These indicate the linguistic evolution of shortened or condensed forms. The intermediate form, *lau-alo,* has become obsolete, in compliance with the general law that intermediate forms or types, whether in linguistic or organic evolution, tend to become extinct. Compare with these names for the kalo leaf the names *lau-ko* and *la-o,* sugar-cane leaf, and *lau ki* and *la-i,* ki or ti leaf.

The kalo plant is a perennial herb having large, succulent leaves. Some of the ornamental kalos are called "elephant ears," from the fancied resemblance of the huge leaves to the flapping ears of the elephant. The leaves are borne aloft on tall, stocky, flexible petioles, which are of pithy structure, but amply strong to support the generous expanse of leaf surface. The petioles arise at the surface of the ground from the top or summit of the starchy corm. In Hawaiian the petiole is *ha.* This word is also applied to the outside leaves of kalo when they are killed by cold or drought. Each petiole is grooved along its inner surface, and well-rounded on its outer surface, and thus fits snugly around its companions in the bud. This grooving or "u-bar" effect is also a mechanical device whereby greater strength is secured than if the material were disposed in a simple cylindrical manner. The substance of the petiole is relatively weak and pithy, but due to the arrangement of the various tissues, and their normal condition of being swollen with water (turgidity), the petiole is rendered strong for its burden. If the water is drawn out of the tissues of the petiole, as by excessive evaporation, it "wilts," and is not able to sustain the leaf. The Hawaiians call *ae* the liquid or juices that can be wrung from the leaves of such vegetables as kalo.

The leaf-blade itself is shield-shaped or peltate. The juncture of the petiole with the leaf-blade, is called *piko,* in Hawaiian. The blade is disposed at such an angle as to catch an abundance of sunlight. The leaves do not overlap very much, so as to shade each other, but rather fill in all the available spaces, and avoid infringing upon each other's territory. This is especially necessary in the case of large, undivided leaves like the kalo, banana

and *ape,* otherwise some of the leaves would be more or less completely shaded, and to that extent unable to participate in the important work of starch-making, as this process can take place only in the presence of sunlight. In the case of such plants as ferns, the leaves of which are commonly much divided, and which do not need direct sunlight (as is evinced by their habitat in shady woodlands), this shading of the leaves is not so detrimental, and the leaves are therefore frequently crowded into dense rosettes.

The kalo leaves may rise from one to five feet above the ground, varying according to the variety, and to the conditions under which it is growing. Wild kalo, growing in shaded places, commonly has long, spindling petioles, as a result of the leaves' struggle to attain the sunlight. In order to support the broad expanse of leaf-surface the veins are prominently developed. This may be easily seen by examining the under-surface of a leaf. This prominent skeleton of veins in the kalo leaf is in striking contrast to the absence of such a supporting framework in the body of such a plant as the sea-lettuce, which is abundant along many Hawaiian beaches, and resembles wet, green, crumpled tissue paper. The sea-lettuce lives in quiet tidal pools, and so has little need for skeleton or rigid framework.

Just within the edge of the kalo leaf is a continuous vein parallel with the margin and connecting the ends of the lateral veins. This peripheral vein strengthens the margin of the leaf and aids in preventing tearing by the wind or other agencies. Many large entire leaves are protected in this manner. A notable exception is the banana, whose leaves have no such marginal veins, and are therefore usually blown to tatters. The peripheral vein of the kalo leaf opens, by means of large pores, out through the margin. "Frequently in sunshine immediately after rain there is a superfluity of water in the plant, and this is reduced by the discharge of water through these pores—a phenomenon known as 'weeping' which is rather common among the aroids."—Barrett.

The kalo leaves are remarkably smooth textured. The leaves of many plants are characterized by hairy or wooly coverings, but the kalo leaf is entirely devoid of such protection. Immunity is secured by the presence, in all parts of the plant, of acrid substances and gummy secretions. The yellowish juice or latex upon exposure to the air rapidly thickens and turns brownish, forming a viscid gum. The true sap produces an indelible reddish-brown stain.

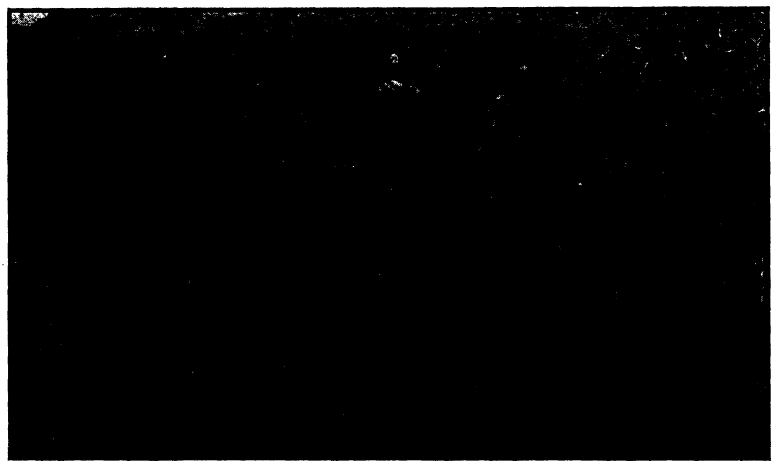
A slight shower fills the concavity of a horizontal kalo leaf with a tiny pool that glistens like quicksilver. Wild kalo frequently grows near the springy places where the woodland wayfarer pauses for a drink. Its freshly-plucked leaf, folded across the base, is a most convenient and artistic cup.

The young leaves are formed in the center of the plant, being furled each within the petiole of the next older leaf. One by one

these delicate younglings protrude from the base of the innermost leaf. Day by day they unfurl till fully spread out in the sunshine to do their work for food manufacture. All parts of the plant are useful—the young leaves (called *haha* or *liko*) and flowers are cooked and eaten as *lu'au* or greens.

Lu'au is made from the delicate inner leaves of the kalo top. The outside leaves were only used as wrappers around the bundle of kalo when cooked in a native oven. As the young leaves are picked in an unfurled state, those who wish to sell a poorer quality of older leaves for greens are in the habit of carefully furling or rolling them so as to imitate the genuine article. Since *lu'au* was an essential part of every native feast, the term *lu'au* has come to be a designation for the feast itself.

The older, outer leaves are designated *la-ele*. This is a shortened form of *lau-ele,* which is the obsolete original form, and means literally a dark or brown leaf. These tough, weather-worn outer leaves are not suitable for use as food, as was indicated above. They are used as food for swine; may be put onto the kalo field for fertilizer; or may be used as wrappers around the bundle of kalo when cooked in the native oven. When used as fertilizer on the kalo patch they are called *kipulu*.



A KALO LO'I NEWLY PLANTED.

Note the *huli makua*; the saturated soil; the embankments overgrown with coarse grasses and wild Canna. The irrigation water entrance shows above center of picture, and exit near lower right-hand corner.

YOUNG KALO.

Each plant has put forth two or three leaves. Note the irrigation water in lower right-hand corner; the adjoining patches; the embankments; the manner in which the soil has been broken up. The banks are covered with *honohono* (Oplismenus compositus.)

INSECT CONTROL.

The following extracts are from notes by C. R. Jones, entomologist, in the *Philippine Agricultural Review*:

The losses caused by insects to various crops, garden truck, and shade trees is far in excess of that supposed by the general observer. This loss is steadily on the increase instead of on the decrease, due to the fact that agricultural areas are becoming larger, thus destroying natural food plants of insects and introducing a new environment. Insects that were formerly unknown as a pest may become noxious on closely allied cultivated plants due to the change in environment and the destruction of the normal host plant; thus we see that the injuries caused by insects and the loss in money value are gradually increasing.

There are several factors which come under the head of natural agencies regarding the control of insects; these may be classed as climatic conditions, and predatory and parasitic enemies. In the control of an insect pest, we should, in addition to these combined natural agencies, apply our artificial means in an energetic, syste-

matical, and coöperative campaign so far as possible. The combined efforts on the part of the planters in a given locality are absolutely necessary, as the efforts of a single person combating or entirely eradicating an insect pest in a single field are of no avail when possibly his next neighbor's field is an ideal breeding place sufficient to supply the entire community.

In order to ascertain when and by what means active measures should be taken in regard to any pest, it is first necessary to study the habits and life history of the insects in question and it is here that the planters can aid greatly by reporting injurious insects and submitting to this Bureau specimens of the plants attacked, together with live and alcoholic insect material.

Numerous requests are made on this Bureau for remedies for various insects, but in most cases they simply state that "an insect is injuring the crops" and ask for the best method of treatment. To requests of this kind it is impossible to give any definite answer without knowing the kind of insect or its method of attack.

Sometimes we receive notice that insects are destroying coconuts, palay, shade trees, or other plants, and we are requested to make an investigation. It is not infrequent that we find, upon investigation, merely the results of the insects, or that the latter are in the last stage of development and that the damage by the prevailing generation is already done. In such cases treatment is of no avail. The danger is over and the plants are safe until the appearance of the succeeding generation. If these insects had been reported in due time, their ravages could have been checked, or a study of the life history and habits could have been made and a remedy given for future outbreaks.

In order for us to give remedies and answer questions intelligently, persons requesting information relative to destructive insects should observe the following points:

1. Insect ravages should be reported at first appearances and not when damage is done.
2. Always submit specimens of the insects in question and of the infested plants.
3. Give the general character of the injury and extent of damage.
4. State the part of the plant attacked.
5. In submitting specimens put them in alcohol or "vino" and give all possible information concerning the insect and its habits.

NATURAL INSECT CONTROL.

Many factors, such as birds, climatic conditions, predatory and parasitic insects, may be placed under the heading of natural insect control. Of these, parasites may be put at the head of the list, as they attack various insects in the egg, larval, pupal, and adult stages. Hymenopterous parasites are probably in excess of all other orders of insects.

A noteworthy incident of natural insect control occurred recently when the eggs of a Pierid were parasitized by a small Hymenopter to such an extent that the ravages of the last generation of this insect were rendered negligible.

The eggs of this Pieridae are deposited singly on the under side of the leaves of *Cassia siamea* Lam. Upon hatching, the larvae have heretofore, during the course of their development, completely defoliated the trees which they had attacked.

During November of last year eggs were noticed to have been deposited liberally on the leaves of these trees; some were taken to be bred in the laboratory, and preparations were made to spray the trees when the eggs should have hatched. The collected eggs hatched, but those on the trees did not. Upon examination the latter were all found to be parasitized.

PLANTS RESISTANT TO INSECT ATTACK.

Plants often resist insect attack by "abnormal" growth and by exuding a sticky sap or other similar substance. A noteworthy instance of a plant resisting the attack of insects occurs in the seed heads of lettuce (*Lactuca sativa* L.). Upon the slightest touch to lettuce seed heads this plant exudes a milky, sticky substance, and when the insects alight upon it they are immediately fastened to the plant, and in their efforts to get away the plant is disturbed still more, causing it to throw out still greater quantities of this protective latex, till at last the insects are held rigid and thus soon die. Lately, at Singalong, it was noted that the lettuce seed buds were covered with dead insects, including the following:

Pentatomidae: *Nazara viridula* Fabr.; *Eurydema pulchrum* Westw.

Phrrhocoridae: *Dysdercus singulatus* L.; *Dysdercus poedilus* H. S.

Capsidae: One species; Hymenopterous parasites, four species; Diptera and Microdiptera, five species.

Chrysomelidae: *Aulacophoro coffeae* Hornst; one other species.

Lygaeidae: One species.

Reduviidae: One species.

CINCHONA.

Ever since the efficacy of quinine against malarial fevers was discovered and the drug introduced into Europe in 1639, there has been great interest in the plants from which this valuable drug is obtained, especially among those European nations possessing colonies in the tropics, and subsequent to the introduction of the cinchona plant into India in 1861 its cultivation has spread over considerable areas in that country; it is also extensively cultivated in Java.

The cinchona is indigenous to tropical South America, occurring between the tenth and the twentieth degree of latitude and is found at its best at an altitude of from 450 to 1800 meters. The number of species that yield quinine is considerable, but there are only a few that are sufficiently rich in the drug to warrant their exploitation for this purpose. *Cinchona calisaya* Weddell, of which there are several varieties, is richest of all in quinine (containing 5 to 6 per cent.) and therefore this species is the one most extensively cultivated. One of its best-known forms is *C. ledgericena*. *C. calisaya* is a tree very variable in size that thrives best at an elevation of 450 to 900 meters. *C. succirubra* Pavon attains a height of 15 meters or more, and succeeds up to an altitude of 1800 meters, preferring a cool climate. *C. officinalis* Hooker is a straggling tree some 6 meters in height; like the preceding species it does best in the higher elevations. The cinchonas succeed best on hillslopes where the soil is rich and well drained and where the rainfall is fairly abundant, though in this latter respect they are not so exacting as was formerly thought. The plants are easily propagated from seeds or cuttings.

It is quite probable that the cinchonas will thrive in many parts of the Philippines having the right qualifications and the Bureau of Agriculture has recently introduced *C. calisaya* with this object in view. — P. J. Wester, in *Philippine Agricultural Review.*

COCONUT AND COCOA.

The world is consuming hundreds of tons of coconut "butter" daily. We are also using one way and another very large amounts of cocoa butter, which is translated cacao tallow. This tallow, made as a by-product in chocolate manufacture, is a very highly nutritious food in itself and a sort of flavoring "filler" for many sorts of confectionery, etc. It is also extensively used by the medical profession.

While formerly it was considered of not much value, largely on account of its use being hardly understood, it is now worth more than the product itself, something like 2 pesos a kilo. Unfortunately the British, and to some extent the American, manu-

facturers persist in using this old-fashioned and more or less execrable word "cocoa" instead of cacao. Not only in resemblance of words, then, but actually in commerce, do these two comparatively new vegetable "butters" stand as rivals.—O. W. Barrett, in *Philippine Agricultural Review.*

WATERING OF CUTS IN RUBBER TREES.

A paper has recently been published in the *Agricultural Bulletin of the Federated Malay States* (Vol. I, No. 7) which is important from two points of view. In the first place it contains results that are likely to be of practical value, and in the second place it affords an example of an original investigation that has been undertaken by a planter. The first experiment in the investigation was designed to show whether the commonly practised custom of watering cuts lengthened or shortened the duration of the dripping period. In round numbers it was found that when the cut was watered the tree continued to drip for eighty-one minutes, when the cut was not watered, for 102 minutes; that when the tree was watered it yielded 250 drops, when not watered 510 drops. A second and more extensive experiment led to the astonishing conclusion that one thousand trees would give about ¾ lb. less rubber a day if water were poured on the cuts than they would give if the cuts were not watered.

The reason for this appears to be that the addition of water induces coagulation.—*Agricultural News.*

LIME JUICE AND SCURVY.

The most notable example of the effect of certain substances existing in food in only minute traces is afforded by the investigations that have led to the discovery of the cause of beri-beri. Volume IX of the Annual Reports of the Chemical Society (1912) contains a review of this work, where the well-known fact is referred to, that the disease is prevalent among rice-eating communities in which decorticated or polished rice is consumed. Whole rice does not induce the disease. The substance inhibiting beri-beri has been extracted from rice husks by water or alcohol, and an alkaloid has been isolated to which the name of oryzanin is given. Small quantities of this substance keep animals free from the disease.

More recently, in the *Journal of the Chemical Society* for March, 1913, an investigation along similar lines is referred to, which has brought to light the fact that lime juice contains an anti-neuritic substance which is probably a specific cure for scurvy.

The investigation was hampered by the guinea pigs experimented on refusing to take oats—a diet which leads to scurvy in these animals. Several new nitrogenous compounds were isolated from the lime juice, however, and a continuation of the investigation will in all probability lead to the recognition of lime juice as a valuable source of anti-scorbutic substances.—*Agricultural News.*

COTTON PICKER.

A description is given in the *Experiment Station Record,* for December, 1912, of a new cotton picker, the mechanism of which consists of a 16-inch cylinder, 12 inches long, on which are mounted twenty spindle shaft frames each carrying seven spindles, making 140 picking fingers in all. As the cylinder revolves, the spindles are caused to revolve at high speed as they stand in a vertical position, and the cotton wraps around them. When they come to a horizontal position they are thrown out of gear and the cotton is stripped off and passed to a basket in the rear. It is claimed that this picker will do the work of from ten to twelve men, requiring only a team and driver.

FATE OF TUBERCLE BACILLI OUTSIDE THE ANIMAL BODY.

A very extensive investigation of the mode of dissemination and outside behavior of the organism causing tuberculosis in animals comprises Bulletin No. 161 of the University of Illinois Agricultural Experiment Station. The author of the paper is Dr. C. F. Briscoe.

In the summary of the bulletin it is stated first, that there are four recognized types of tubercle bacilli; human, bovine, avian, and a type that infects cold-blooded animals. The tubercle bacillus does not form spores, nor does it secrete a soluble toxin, though the fact that poisons are produced is well recognized, since tubercles can be brought on in animals by the injection of dead cultures.

The author next proceeds to emphasize the importance of definite knowledge as to the powers of vitality of the organism outside the animal body, namely, its capacity for resisting conditions of environment inimical to its existence.

The tubercle bacillus, although it does not form spores, is one of the most resistant species of bacteria; it can, however, be killed in a few minutes to a few hours when exposed to direct sunlight. The time of killing is less at higher altitudes, but it is ten to fifteen times longer in diffused light.

Tuberculosis sputum reduced to dust and inhaled by animals causes tuberculosis, and a much less amount is necessary to produce the disease by inhalation than by ingestion, though infection by ingestion is believed to be more common than is generally supposed.

It is next pointed out that a decrease in the number of cases of tuberculosis can, in many places, be correlated with an improvement of the water supply. It is reported that tubercle bacilli live for several months to more than a year in water and other material.

As regards the exact time that tubercle bacilli live under certain conditions of environment, it was found that whereas pure cultures of non-spore-bearing organisms and the vegetative cells of spore-bearing germs exposed to direct sunlight in thin smears were killed in half to six minutes, the human, bovine and avian types of tubercle bacilli exposed in the same way were killed in one to four minutes.

The former group of organisms exposed to desiccation in the dark died in one to four days, spores of *B. subtilus* took thirty-five days; the tubercle bacilli, four to eight days.

Pure cultures of bovine tubercle bacillus mixed in cow manure and exposed in a 2-inch layer in a pasture field in the sunshine remained alive and virulent for two months. Guinea pigs inoculated with germs exposed in manure in the shade developed the disease with greater severity than those animals which were inoculated with germs not protected from the sun.

Tubercle bacilli in the manure of a naturally infected cow, exposed in the same manner as the artificially infected manure, were dead within two weeks after exposure, whilst those bacteria in garden soil and in a dead tuberculosis guinea pig buried in garden soil were alive on the 213th and 71st days, respectively, and dead on the 230th and 99th days, after first exposed.

Tubercle bacilli live for more than a year in running water. A watering trough harboring these germs may therefore be a dangerous source of infection to cattle.

Another possible source of infection is the bones of tuberculous animals which have been ground and utilized for manurial purposes. The danger from this source would, however, be obviated if the bones were steamed as is frequently done.—*Agricultural News.*

LEGUME INOCULATION.

MARTIN J. PRUCHA.

(Circular No. 15, Department of Plant Physiology, Cornell University Agricultural Experiment Station.)

During the past ten years much interest has been created in the use of atmospheric nitrogen by bacteria associated with the legume crops. The Department of Plant Physiology at Cornell University has received, within recent years, a considerable number of inquiries with respect to the subject. These inquiries have been particularly concerned with the introduction of the root-nodule-forming bacteria into fields. Questions respecting the "how" and the "when" to inoculate have been numerous. Many of the letters reveal the fact that the writers possess vague or erroneous ideas concerning inoculation. During the past few years the department has been investigating the subject. In order to set forth briefly and simply the essential facts, as well as to call attention to the pure cultures that the department is now distributing, this circular is presented to the public.

FIG. 30.—*Root of soy bean, showing nodules. Natural size.*

DIFFERENCES BETWEEN LEGUMES AND OTHER PLANTS.

Leguminous crops are very rich in protein. Alfalfa hay, for example, is almost as rich in nitrogen as is wheat bran. In fact, all the leguminous crops, whether in the form of hay or of seed, differ from other crops in that they are richer in nitrogen content. They are, therefore, very valuable crops.

There is another point of difference between legumes and other plants. If a leguminous plant is carefully dug up and the roots are washed, a number of wart-like swellings may be seen on the roots. These swellings are commonly called nodules. Photo-

graphs of the roots of soy bean, alfalfa, and Canada field pea are shown in Figs. 30, 31, and 32. The nodules on the roots are of the natural size. It is seen that the size and the shape of the nodules vary with the different legumes. Under certain conditions very large nodules may develop. In Fig. 33 are shown roots of the Canada field pea grown in a loamy soil, the nodules being of the natural size.

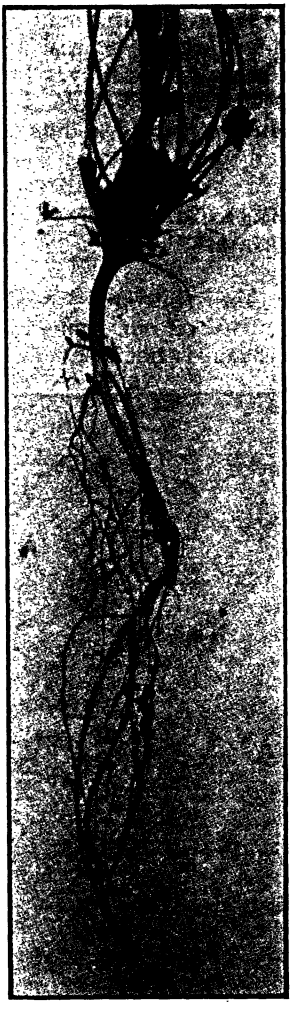


FIG. 31.—*Root of alfalfa, showing nodules. Natural size.*

Another point of interest, especially to farmers, is the fact that leguminous crops seem in some way to add a little fertility to the soil on which they are grown. For many centuries past, farmers have observed that non-leguminous crops, as wheat, corn, potatoes, and the like, grown on land on which clover or some other legume was raised the year before, invariably gave a better yield. It was not understood at first, but scientific study in recent years has shown that legumes may add a certain amount of nitrogen to the soil.

There are, then, three features that distinguish leguminous crops from other crops:

1. Legume crops are very rich in nitrogen.
2. Legumes have nodules on the roots.
3. Legumes add fertility to the soil.

NODULES CAUSED BY BACTERIA.

If an extremely thin slice is cut from one of the nodules and is magnified under the microscope about one thousand times, a large number of little rod-like bodies can be seen. Some of them are sausage-like in shape, and others may send out short outgrowths so that they are often called X and Y forms. These bodies are bacteria. In Fig. 34 are shown a few of the forms of the bacteria found in the legume nodule. They are living plants and, like other living organisms, they can

grow and multiply. They are so small that they are not visible to the naked eye; fifteen thousand of them attached end to end would not extend more than one inch. These bacteria may live in the soil, and when they come in contact with a legume root they make their way into it and there begin to multiply. In a few days the root develops a swelling, which is a nodule, near the point where the bacteria entered. In the mature nodule are millions of these bacteria.

LEGUMINOUS PLANTS WITH NODULES ENABLED TO USE FREE NITROGEN FROM THE AIR.

Chemists state that four-fifths of the air is nitrogen—an unlimited supply—but the plants that are raised on our farms cannot use this nitrogen because it is a gas and is not available to them. It has been observed, however, that when nodules develop on the roots of a leguminous plant, that plant is supplied with nitrogen which comes from the air. The bacteria that produce the nodules seem to have the peculiar ability to use nitrogen from the air and in some way to supply the leguminous plant with it. It is not known how the bacteria in the nodules of the leguminous plant get nitrogen from the air, but it is known that a leguminous plant with plenty of nodules on the roots accumulates a relatively large amount of nitrogen inside its tissues, and that a certain part of this nitrogen comes from the air.

FIG. 32.—*Root of Canada field pea, showing nodules. Natural size.*

Amount of nitrogen taken from the air by a leguminous crop.

Since it is well known that legumes use nitrogen from the air, farmers are naturally interested to know the amount of nitrogen that may be taken from the air by a leguminous crop. This is very difficult to decide. Many experiments have been made in order to determine this, but such experiments have been performed under special conditions. The results obtained, therefore, must not be

applied too closely to field conditions. One of such experiments is reported in Bulletin 147 of the Rhode Island Agricultural Experiment Station. Several different legumes were grown in special flowerpots and the amount of nitrogen was determined both in the plants and in the soil. The authors of the bulletin found that all the different legumes that they grew were able to obtain some nitrogen from the air. From their experiments they found that an acre of soy beans may take about 1000 pounds of nitrogen from the air during a period of five years, or 200 pounds per year. Seven-tenths (140 pounds) of the 200 pounds were removed in the crop, and three-tenths (60 pounds) remained in the soil. Since one pound of nitrogen costs about 16 cents, 200 pounds would cost $32.

We must be cautious and not jump at the conclusion that every acre of soy beans or any other legume crop, grown in any soil and under all kinds of conditions, would take out of the air an amount of nitrogen worth $32. In some cases it may be done, but in most cases such an amount of nitrogen is probably not removed from the air by an acre of legumes. One thing is established, however, and that is that the legumes with nodules on the roots are enabled to use a certain amount of the atmospheric nitrogen and that the legumes without nodules are not able to do so.

INOCULATION.

We have learned from observations that nodules may not develop on all the different legumes in all soils. From this we conclude that the bacteria which produce nodules are not always present in every field. We find that legumes such as clovers, which have been raised on almost every farm in this State for many years, generally produce plenty of nodules in most soils. Legumes such as alfalfa, soy beans, and cowpeas, however, which are relatively new crops in this State, do not generally produce nodules. Since it is the bacteria that cause the nodules, and since legumes without nodules are not able to get any nitrogen from the air, it is to our advantage to introduce these nodule-forming bacteria into our fields. Inoculation, therefore, is the introduction into the fields of the bacteria that cause nodules on leguminous crops.

CROSS-INOCULATION.

Can one legume be inoculated with the bacteria from a different legume? This question is often asked by farmers.

It seems to be well established that alfalfa can be inoculated with the bacteria from sweet clover. Successful cross-inoculation is obtained also between red clover, white clover, and alsike clover. In general it may be stated that cross-inoculation takes

FIG. 33.—*Root of Canada field pea, showing very large nodules. Natural size.*

place between closely related legumes. Cross-inoculation is not successful between alfalfa, clover, Canada field pea, soy bean, and cowpea. But even when cross-inoculation is successful, there is no evidence to show that it is as efficient as when the legume is inoculated with its own bacteria. The information on the subject of cross-inoculation is meager and the practice is not recommended.

FIG. 34.—*Legume bacteria, highly magnified.*

HOW TO INOCULATE.

There are two ways in which inoculation may be accomplished, the soil method and the pure-culture method.

Soil Method.

When we find nodules on a legumionus crop, we know that in the soil where the crop is being grown there are nodule-forming bacteria. If we take a certain amount of this soil and scatter it over a new field we introduce into the new field, along with the soil, some of the bacteria. In practice, usually about two hundred pounds of soil broadcasted on every acre will be sufficient to inoculate the field. This is a simple method of inoculation and good results are invariably obtained. There are, however, some drawbacks to it. It is not always easy to get the soil, and because of its bulk it is difficult of transportation. A more serious objection to the soil method of inoculation is that when the soil comes from an unknown field various weed seeds, diseases, and insects may be in it. In that case such pests would be introduced into our field and would cause trouble. Dodder, for example, may be spread in this way. Therefore one should bear this in mind when considering the use of soil for inoculation. The method is especially well adapted for inoculating one field with soil obtained from another part on the same farm.

The writer believes that the simplest and most economical way to inoculate is, not to plant and inoculate a large acreage at first, but to plant one acre or less of the particular legume and inoculate a part of it, leaving the other part uninoculated. If the plants on the inoculated part of the field look greener and healthier than those on the uninoculated part, and in addition have an abundance of nodules on the roots while the plants on the uninoculated part have no nodules or very few, the field needs inoculation. This practice has two advantages: in the first place, the farmer learns whether the soil needs inoculation for the particular legume; and in the second place, in case inoculation is needed, the soil from the inoculated part of the field

is as good inoculating material as any other. The whole farm can then be inoculated with very little cost to the farmer.

Pure-culture Method.

In order to make the inoculation more simple and to meet the various objections against the soil method, investigators have devised the pure-culture method. The nodule-forming bacteria are carefully removed from the nodules and are made pure. In making the nodule bacteria pure we separate them from all kinds of molds and other undesirable bacteria. When they are purified they are planted on some sterilized food in which they can multiply. In such food an extremely large number of the bacteria may develop in a few days. When the nodule bacteria are propagated in this manner the preparation is called a pure culture.

In some cultures the bacteria are propagated in liquid, in others on vegetable gelatin, and in still others unknown mixtures are employed. After considerable investigation this department decided to employ sterilized soil as a medium in which to grow the bacteria in pure culture.

In using pure cultures for inoculation, the object to be attained is to distribute the bacteria evenly over the entire field. Two methods may be employed in order to accomplish this: (1) The pure cultures may be mixed with a certain quantity of water and then poured on the seed. The seed is stirred until each one is moistened and is then ready for planting. It is assumed that some bacteria will adhere to every seed and will be carried with it into the soil. (2) When it is not convenient to treat the seed as above described, the pure cultures may be mixed thoroughly with loamy soil, allowing about two hundred pounds of soil for each acre. The soil is then broadcasted over the field and harrowed in.

The pure-culture method of inoculation has some advantages. Being pure, ther are no weed seeds, no insects, no diseases nor undesirable bacteria, provided the culture is prepared properly. It is easily obtained, easily handled, and should be cheap.

In general, a new discovery of this kind does not at first always give good results. This was true in the case of pure cultures. The reason for these failures is very simple. At first not enough was known about the nature and the habits of these nodule-forming bacteria, and consequently they were not treated properly. The result was that often, by the time the farmer procured the culture, the bacteria in it were all dead or some wrong kind of bacteria had entered into it. Investigators have learned, however, by the failures. The writer believes that at present enough is known about these bacteria to enable workers to prepare pure cultures that will give good results.

WHEN INOCULATION IS NEEDED.

To inoculate each leguminous crop every time it is planted requires both labor and money, and it is a waste if inoculation is not needed. On the other hand, if the crop is not inoculated, and inoculation is needed, the farmer loses money. So it becomes of some importance to know what leguminous crops should be inoculated.

There is only one known way by which the farmer can learn with certainty whether inoculation is needed, and that is to grow the crop in the field. If the root-nodules do not develop at all, or develop on only a few isolated plants, that leguminous crop needs inoculation when planted in that field. If, however, some nodules are present on almost every plant, inoculation is probably not needed. The simple experiment described on page 29 can be carried out by any farmer. By performing such an experiment he can readily ascertain which of the leguminous crops need inoculation when planted on his farm. To perform such an experiment, however, takes time, and many farmers may prefer to inoculate each leguminous crop rather than to take time for experimenting. Although there is no other known way of finding out with certainty as to the need for inoculation, there is a certain amount of information that is helpful in deciding the question.

Leguminous crops such as clover, peas, beans, and others that have been grown on farms in this State for many years, probably need no inoculation. There are some persons, however, who assert that it pays to inoculate every leguminous crop every time it is planted. It may be true that such a common crop as red clover may be improved by inoculation, even in New York State where it has been grown extensively for many years. It has never been proved conclusively one way or the other; but the writer's opinion, based on casual observation, is that soils on most farms in New York State are naturally well inoculated with the bacteria that produce nodules on legumes that have been repeatedly raised on the farms. On the other hand, alfalfa, soy beans, cowpeas, and any other leguminous crop that has never been raised on the farm, as a rule need to be inoculated when planted for the first time.

That inoculation is needed in most cases when alfalfa is grown for the first time has been shown in Bulletin 313 of the New York (Geneva) Agricultural Experiment Station. In one hundred and three experimental fields of alfalfa, distributed in thirty-nine counties of this State, only twenty-five were successful without inoculation. The authors say that in beginning to grow alfalfa proper inoculation of the soil is a point that is worthy of the careful attention of any farmer in this State.

WHY INOCULATION IS NOT ALWAYS SUCCESSFUL.

It occasionally happens that inoculation does not produce good results. There are various reasons for this, but usually it is due to the poor quality of the culture or to the condition of the soil. The culture must not always be blamed. We all know that some crops grow well on our farms, while others may grow poorly or not at all. Bacteria are living plants, and in order to enter the roots and produce nodules they must live and multiply in the soil. There are some soils in which the bacteria will not live and no amount of inoculation will produce good results. Or it may be that the particular leagume does not grow well in the soil. In either case good results from inoculation cannot be expected. The fault of the soil must first be corrected. It has been found that an application of lime—about a ton per acre—invariably benefits certain of the legumionus crops, alfalfa in particular. In Bulletin 313 of the New York (Geneva) Agricultural Experiment Station there are given some interesting results on the benefit of lime for alfalfa. Sixty-four alfalfa fields, well distributed over the State, showed that only eleven were successful without lime, and all the fields except six were improved by the addition of lime.

STERILIZED SOIL CULTURES.

As previously indicated, this department has developed a method for distributing nodule-forming bacteria in pure culture. It has found that in sterilized which, which it uses, these bacteria multiply readily, as many as three billion being present in an ounce of the soil. During the past two years a limited number of these cultures have been distributed, principally for experimental purposes. Because of the favorable results obtained the department proposes to distribute the cultures for general use among the farmers of the State.

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PUBLICATIONS FOR DISTRIBUTION.

Any one or all of the publications listed below (except those marked *) will be sent to residents of this Territory, free, upon application to Mailing Clerk, P. O. Box 207, Honolulu.

BOARD.

Report of the Commissioner of Agriculture and Forestry for 1900; 66 pp.
Report of the Commissioner of Agriculture and Forestry for 1902; 88 pp.
* First Report of the Board of Commissioners of Agriculture and Forestry, from July 1, 1903, to December 31, 1904; 170 pp.
Second Report of the Board of Commissioners of Agriculture and Forestry, for the year ending December 31, 1905; 240 pp.; 8 plates; 10 text figures.
Third Report of the Board of Commissioners of Agriculture and Forestry, for the year ending December 31, 1906; 212 pp.; 3 plates; 4 maps; 7 text figures.
Fourth Report of the Board of Commissioners of Agriculture and Forestry, for the calendar year ending December 31, 1907; 202 pp.; 7 plates.
Fifth Report of the Board of Commissioners of Agriculture and Forestry, for the calendar year ending December 31, 1908; 218 pp.; 34 plates.
Report of the Board of Commissioners of Agriculture and Forestry, for the biennial period ending December 31, 1910; 240 pp.; 45 plates.
"Notice to Importers," by H. E. Cooper; 4 pp.; 1903.
"Digest of the Statutes Relating to Importation, Soils, Plants, Fruits, Vegetables etc., into the Territory of Hawaii" Gereral Circular No. 1; 6 pp.

PUBLICATIONS FOR DISTRIBUTION—Continued.

"Important Notice to Ship Owners, Fruit Importers and Others. Rules and Regulations Prohibiting the Introduction of Certain Pests and Animals into the Territory of Hawaii." General Circular No. 2; 3 pp.; 1904.
"Law and Regulations, Importation and Inspection of Honey Bees and Honey." General Circular No. 3; 7 pp.; 1908.

"The Hawaiian Forester and Agriculturist," a monthly magazine. Vols. I to VII; 1904-1910. To be obtained from the Hawaiian Gazette Co., Honolulu. Price $1 a year.

DIVISION OF FORESTRY.

* "Forest and Ornamental Tree Seed for Sale at Government Nursery." Press Bulletin No. 1; 3 pp.; 1905.
* "Suggestions in Regard to the Arbor Day Tree Planting Contest." Press Bulletin No. 2; 7 pp.; 1905.
"An Offer of Practical Assistance to Tree Planters." Circular No. 1; 6 pp.; 1905.
"Revised List of Forest and Ornamental Tree Seed for Sale at the Government Nursery." Press Bulletin No. 3; 4 pp.; 1906.
* "Instructions for Propagating and Planting Forest Trees." Press Bulletin No. 4; 4 pp.; 1906.
"Instructions for Planting Forest, Shade and Ornamental Trees." Press Bulletin No. 5; 7 pp.; 1909.
"Na Hoakaka no ke Kanu Ana i na Laau Malumalu ame na Laau Hoohiwahiwa." Press Bulletin No. 6; 8 pp.; 1909.
"Eucalyptus Culture in Hawaii," by Louis Margolin. Bulletin No. 1; 88 pp.; 12 plates; 1911.
Report of the Division of Forestry, for the year ending December 31, 1905. Reprint from Second Report of the Board; 77 pp.; 5 plates.
* Report of the Division of Forestry, for the year ending December 31, 1906. Reprint from Third Report of the Board; 123 pp.; 4 maps.
Report of the Division of Forestry, for the year ending December 31, 1907. Reprint from Fourth Report of the Board; 70 pp.
Report of the Division of Forestry, for the year ending December 31, 1908. Reprint from Fifth Report of the Board; 85 pp.
Report of the Division of Forestry, for the biennial period ending December 31, 1910. Reprint from Report of the Board; 86 pp.; 22 plates.

DIVISION ON ENTOMOLOGY.

"The Leaf-Hopper of the Sugar Cane," by R. C. L. Perkins. Bulletin No. 1; 38 pp.; 1903.
** "A Catalogue of the Hemipterous Family Aleyrodidae," by G. W. Kirkaldy, and "Aleyrodidae of Hawaii and Fiji with Descriptions of New Species," by Jacob Kotinsky. Bulletin No. 2; 102 pp.; 1 plate; 1907.
* "On Some Diseases of Cane Specially Considered in Relation to the Leaf-Hopper Pest and to the Stripping of Cane," by R. C. L. Perkins. Press Bulletin No. 1; 4 pp.; 1904.
"A Circular of Information," by Jacob Kotinsky. Circular No. 1; 8 pp.; 1905.
"The Japanese Beetle Fungus," by Jacob Kotinsky and Bro. M. Newell. Circular No. 2; 4 pp., cut; 1905.
Rule VII: "Concerning the Prevention of Distribution of the Mediterranean Fruit Fly"; unnumbered leaflet; 1910.
Rule VIII: "Concerning the Importation of all Banana Fruit, Banana Shoots or Plants"; unnumbered leaflet; 1911.
Report of the Division of Entomology, for the year ending December 31, 1905. Reprint from Second Report of the Board; 68 pp.; 3 plates; 10 text figures.
Report of the Division of Entomology, for the year ending December 31, 1906. Reprint from Third Report of the Board; 25 pp.; 7 text figures.
Report of the Division of Entomology, for the year ending December 31, 1907. Reprint from Fourth Report of the Board; 18 pp.; 1 plate.
Report of the Division of Entomology, for the year ending December 31, 1908. Reprint from Fifth Report of the Board: 26 pp.; 2 plates.
Report of the Division of Entomology, for the biennial period ending December 31, 1910. Reprint from Report of the Board; 70 pp.; 10 plates.

DIVISION OF ANIMAL INDUSTRY.

* "Inspection of Imported Live Stock." Rule 1; 1 p.; 1905.
* "Inspection and Testing of Imported Live Stock for Glanders and Tuberculosis." Rule 2; 1 p.; 1905.
* "Concerning Glandered Horse Stock in the Territory." Rule 3; 1 p.; 1905.
* "To Amend Rule 1, Inspection of Imported Live Stock." Rule 4; 1 p.; 1907.
* "Quarantine of Horse Stock from California." Rule 8; 1 p.; 1908.
"Rules and Regulations, Inspection and Testing of Live Stock." Rules and Laws; 11 pp.; unnumbered pamphlet; Revised 1910.
Report of the Division of Animal Industry, for the year ending December 31, 1905 Reprint from Second Report of the Board; 62 pp.
Report of the Division of Animal Industry, for the year ending December 31, 1906. Reprint from Third Report of the Board; 41 pp.; 3 plates.
Report of the Division of Animal Industry, for the year ending December 31, 1907. Reprint from the Fourth Report of the Board; 104 pp.; 6 plates.
Report of the Division of Animal Industry, for the year ending December 31, 1908. Reprint from Fifth Report of the Board: 44 pp.
Report of the Division of Animal Industry, for the biennial period ending December 31, 1910. Reprint from Report of the Board; 59 pp.; 13 plates.

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* Out of print.